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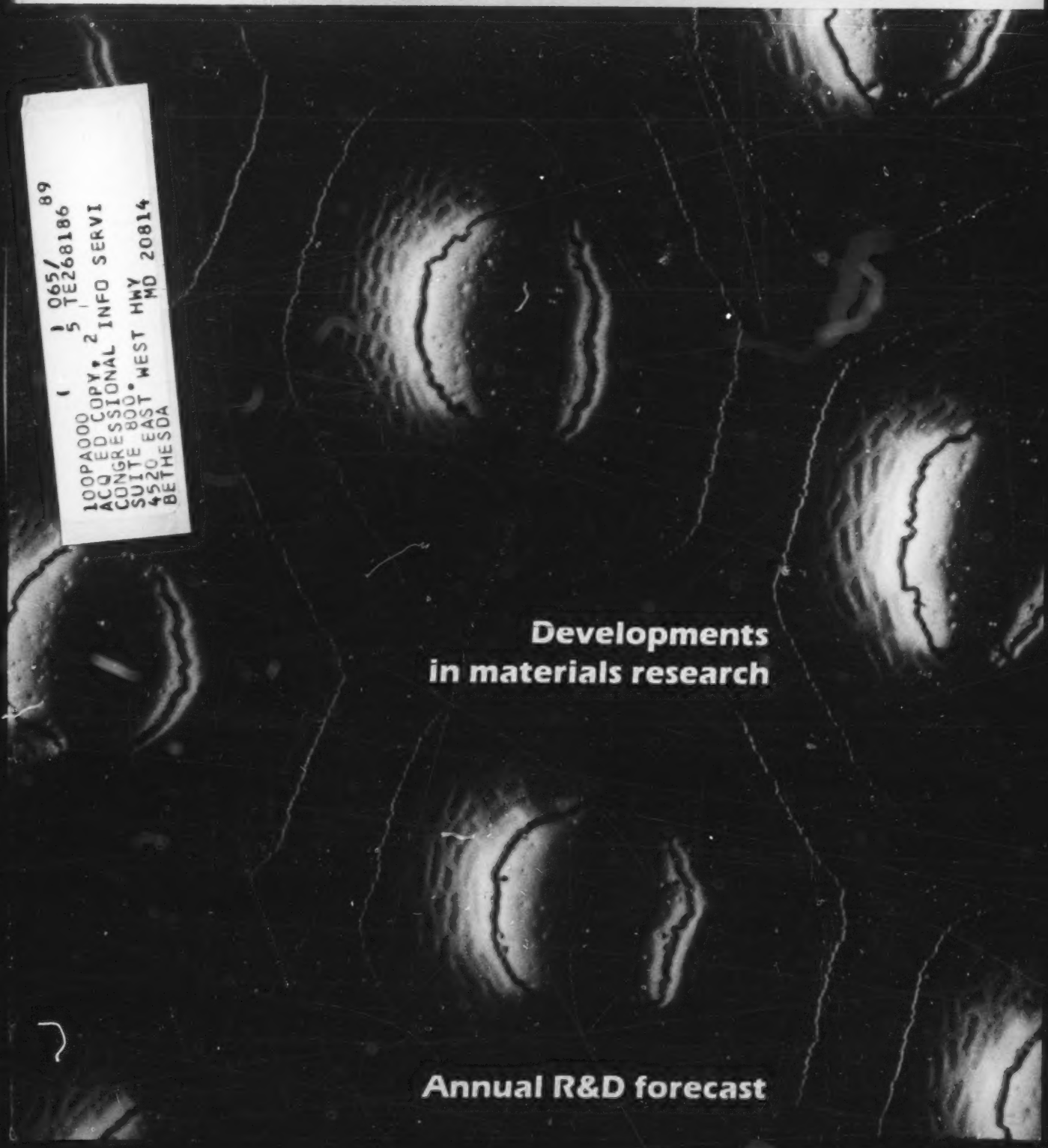

Developments in materials research

Annual R&D forecast

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Research & Development

The magazine with the **R&D 100 Awards**

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This year will bring new emphasis on superconductors. This one uses a vanadium barrier to contain tin within conducting wires. When heated, the tin and niobium react to form Nb_3Sn.

Micrograph by P.E. Danielson, Teledyne Wah Chang, Albany, OR, furnished by Carl Zeiss Inc.

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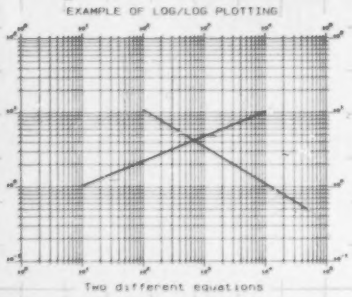

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R&D funding in U.S. will hit $132 billion in 1988

Barring further economic calamities, total funds available for research and development will increase adequately to allow some small real growth this year.

C.J. Mosbacher
Consultant, *R&D* magazine

BLACK MONDAY, Gramm-Rudman-Hollings or a budget compromise between the Administration and Congress, a falling dollar, and a continuing trade deficit: Will these factors cause a research and development recession in the United States? From what we have been told by leaders in industry and in government, academia, and other nonprofit organizations, the answer is a definite NO.

On that same basis, coupled with consideration of available data on research and development funding and expenditures, we project funding of $132 billion for R&D in the calendar year 1988.

Portions of the data are from studies and projections of the general economy, business, and industrial sectors provided by the Economics Dept. of Cahners Publishing Co. Comments and tabulations of economic indicators that accompany this article were provided by that department.

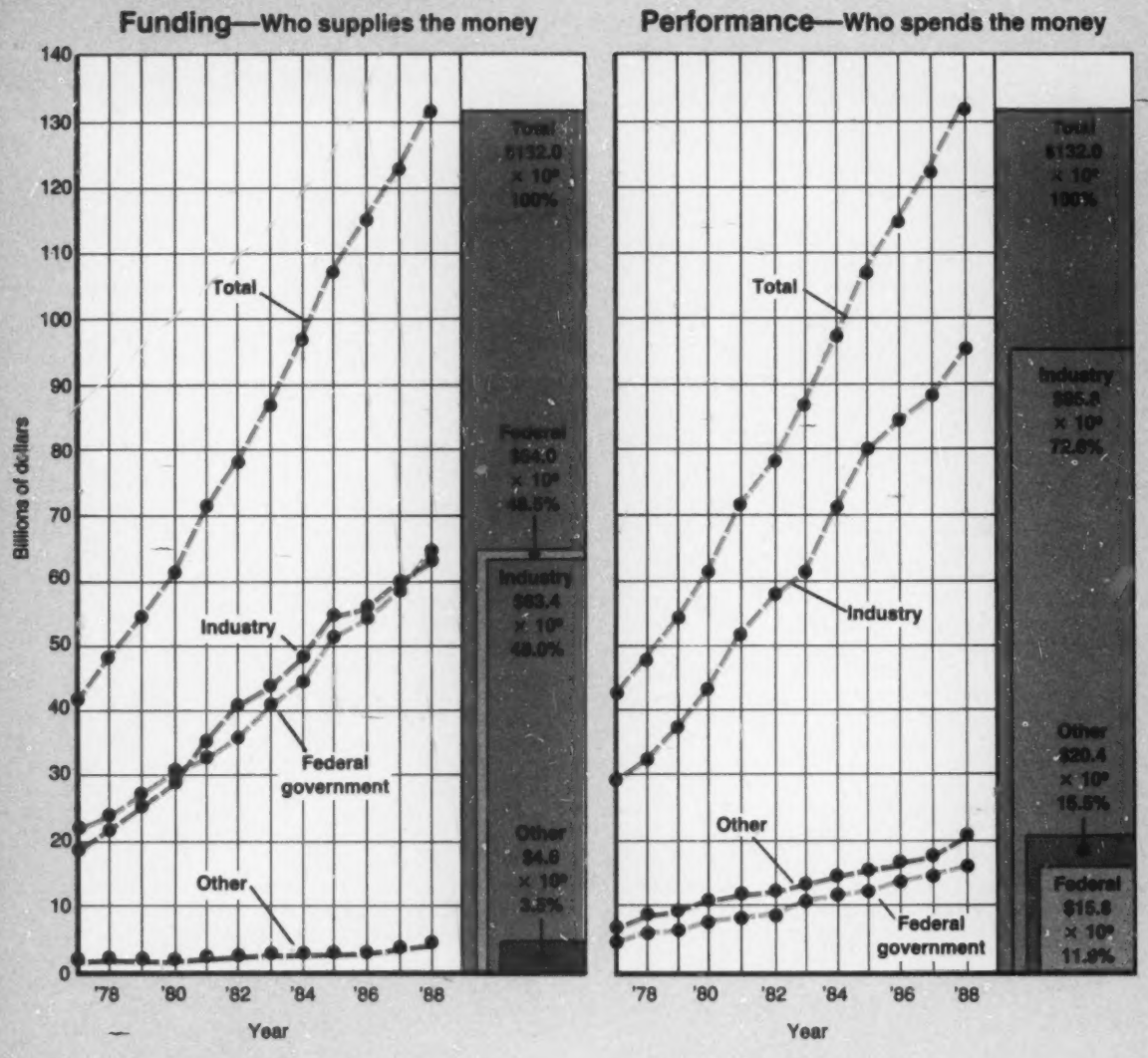
A year ago, this Forecast projected 1987 funds for research and development of $125 billion. As explained later in this article, information now available has resulted in a revised 1987 funding figure of $123.6 billion. An increase of 6.8% overall leads to the 1988 funding levels forecast here.

The 1988 total includes funding of $63.4 billion from industry, $64.0 billion from the Federal government, and $4.6 billion from other sources including universities, colleges, and other nonprofit organizations. As percentages of total 1988 funding, industry is projected to provide 48.0%, the Federal government 48.5%, and other sources 3.5%. Essentially, this is the same sectoral pattern for funding as in 1987. The only difference is a shift of 0.1% from industry to the "other" sector.

Considering transfers of funds among sectors, we can project where expenditures will be made for the performance of research and development. Our forecast is that industry will use $95.8 billion in 1988, while Federal government laboratories will use $15.8 billion and other sectors $20.4 billion.

Thus, industry will spend 72.6% of the total dollars available in 1988, the Federal government 11.9%, and other sectors 15.5%. The comparable performance percentages for 1987, based on our revised total of $123.6 billion, are 72.4% for industry, 12.4% for Federal government, and 15.2% for other sectors. Whether these slight changes constitute the beginning of a trend toward more performance of R&D by the academic and nonprofit sectors cannot be established now.

However, in 1987, the number of industry cooperative R&D organizations that was established increased noticeably. In particular, the Dept. of Defense was proposing a $100 million addition to the fiscal 1988 budget for Sematech (a cooperative venture that will use matching funding from industry to develop new



techniques for semiconductor production) and a National Science Foundation program for establishing targeted R&D centers at universities with joint government-industry funding.

In addition, General Electric's gift of the RCA David Sarnoff laboratories to Stanford Research Institute, after GE acquired RCA, in effect transferred $88 million of performance funding from the industrial to the nonprofit sector.

Revisions affect 1986 and 1987 data

As has been our practice in past years, the first step in preparing this forecast is to review and revise earlier forecasts. For example, shortly after the 1987 Forecast was published (*R&D* January 1987, p 68), the National Science Foundation published its "Science and Technology Data Book" (NSF 86-311). It estimated 1986 total research and development at $117.5 billion. Our revised 1986 forecast was $118 billion.

For 1987, the NSF estimate (in NSF 86-311) was $125.2 billion. Our forecast was $125.0 billion. For comparison, the NSF estimates and our forecasts by sector can be expressed in billions of dollars as NSF/*R&D* magazine for funding: industry, 60.5/61.0; Federal government, 60.5/59.8; other, 4.2/4.2. For performance, the comparison is: industry, 91.0/91.0; Federal government, 15.4/15.2; other, 18.8/18.8.

As 1987 progressed, more and more published data indicated that while our forecasts for the Federal government and the academic–nonprofit sectors would

The 1988 U.S. economy in a nutshell

R&D IS BEST VIEWED in the context of the changes that are occurring in the general economy and in industry. Cahners Economics has provided these more-general forecasts and data especially for this Forecast article.

General economic outlook

The outlook for U.S. economic growth took an unprecedented dive in the last quarter of 1987 on the heels of the stock market free-fall and subsequent jitters in the financial markets around the world. Cahners Economics, however, continues to remain relatively optimistic and forecasts real gross national product to grow by 3.1% in 1988. Clearly, this is just average growth, but no recession is looming in the near term.

Our outlook is predicated on a number of factors. First, the current economic expansion is no longer being led by the consumer sector but, instead, by an upturn in the industrial markets. Furthermore, the outlook for consumer spending may not be as bleak as some reports suggest. Even with the post-Black Monday blues and a short-term pullback on purchases of durable goods, consumers are expected to maintain steady spending for nondurables and services throughout the year.

Second, on the investment side, businesses will be throwing a bit more money into their capital spending budgets, especially for equipment. Total manufacturing and new plant and equipment spending will increase by 9.6% by the end of this year as a result of improved profits and trade position. Finally, we expect some restocking of low inventory levels as businesses regain confidence that growth is real. This will continue for at least the next 12 months.

After-tax corporate profits

After two years of declining corporate profits, U.S. industry will see profits increase almost 13% this year, reflecting healthy business conditions. As economic expansions mature, profits have traditionally increased. Also, businesses begin to approach capacity constraints, lead times begin to lengthen, and businesses find that in such an environment they can raise margins.

This has been particularly true during this business expansion because of the declining dollar. U.S. exports are more attractively priced in foreign markets, and U.S. businesses can use this strategic advantage to regain market share or increase margins.

Business investment

The improved trade situation, increased profits, and relatively reasonable interest rates will have a positive effect on business investment. Although investment in 1987 increased less than 1.0% compared to 1986, investment in 1988 will increase by about 6.3%. This certainly is not the rate achieved in the early 1980s, but is respectable nonetheless. Nondefense capital goods spending is expected to outpace defense capital goods outlays, and growth in equipment spending will be greater than investment in structures.

New manufacturing plant and equipment spending will make a major contribution to investment growth in 1988. However, not all industries will participate equally in this investment miniboom. The chemical and nonelectrical machinery industries are expected to increase their investment spending by much more than 10%. By comparison, the auto industry, which invested billions of dollars in 1984 and 1985 in an attempt to remain competitive, will not have such large growth in capital spending budgets for some time to come.

Total industrial production

Industrial production has been expanding since the beginning of 1987. Total production will grow 6.3% this year on top of 3.7% in 1987.

Posting the biggest gains will be the electronics markets as both equipment and components recover from their low levels of activity over the past few years. Other equipment and machinery markets also will do quite well as manufacturers increase their capital spending and the decline in the value of the dollar opens up foreign markets.

Process industries

The process industries have been the stronger half of the manufacturing sector since the current industrial recovery began, but their superior position will be eroded as the recovery in the OEM markets gains momentum. The process industries will continue their pattern of steady, if unspectacular, growth. After an increase of 4.9% in 1987, process output is expected to rise another 4.9% in 1988 before dropping slightly in 1989.

OEM industries

The industrial production indices that measure the output of the OEM industries have been steadily advancing since the first quarter of 1987. The aggregate index for the OEM industries computed by Cahners Economics is up 3.3% since December 1986. Increases in shipping activity by manufacturers in the OEM sector have closely followed the production increases—total shipments through the first three quarters of 1987 were up 3.8% over the same period last year.

Despite the fluctuations in the financial markets, the outlook for the OEM industries through 1988 is for continued growth. Unemployment is low, and foreign demand for U.S. goods is increasing because of the weaker dollar. The unpredictable psychological effects of the stock market drop and the budget and trade deficits may result in a muted expansion, but 1988 will still be a good year for most manufacturers in the OEM sector, particularly electronics. Total OEM output will increase 7.3% by year-end 1988.

Comparative prices

At the end of the third quarter of 1987, nearly 75% of the buyers surveyed by *Purchasing* magazine reported price increases for industrial commodities. That is the highest level since the current expansion began five years ago.

Industrial prices will continue to rise well into 1988, in many cases by 20% or more. The increases will be more widespread this year, as rising import prices and growing export demand puts added pressure on suppliers of basic industrial commodities. In addition, wage inflation, which has been very slow for the past few years, will begin to fuel prices this year.

need only slight revision, industrial funding and performance would have to be substantially reduced.

For example, in its "R&D Scoreboard" (June 22, 1987), *Business Week* magazine reported that the 859 companies topping the list of R&D spenders in industry had expenses of $50.9 billion in 1986. The *Business Week* annual scoreboards are traditionally lower than either our forecasts or NSF data, but not significantly lower.

Such data led us to seek more information about 1986 and 1987 funding and expenditures as we discussed plans for 1988 with leaders of industry, trade associations, academia, nonprofit groups, and government. We found that we had misjudged the timing of a significant downturn in the rate at which industry was increasing its R&D funding.

Annual increases of more than 12% prior to 1984 did not continue but started a drop to an average rate of about 6% from 1984 through 1987. A principal cause of the lower growth was that sales and profits were lower than expected in many parts of industry. Short-term profit goals adversely affected industry funding of basic and applied research, and tax changes impacted corporate after-tax profits in 1987.

Mergers and attempted mergers also limited funding for research and development as corporations restructured financially and took on additional debt burdens. An extreme example was the closing of Borg-Warner's research center as part of a defense against an unwanted takeover.

Backtracking, we revised our industry funding levels to $56.5 billion for 1986 and to $59.4 billion for 1987. That is a 2.6% reduction for both years.

For Federal funding, our studies led us to reduce the 1986 figure from $56.0 billion to $55.5 billion. For 1987, we increased the figure from $59.8 billion to $60.0 billion, primarily because appropriation delays shifted some funds from the first quarter of fiscal 1987, which started on October 1, 1986, into calendar 1987.

For the other—academic and nonprofit—sector, our studies led us to retain our previously revised 1986 funding figure of $3.9 billion, as well as the $4.2 billion figure originally forecast for 1987.

Combining these data resulted in a re-revised 1986 total funding figure of $115.9 billion, 1.8% less than the revision included in last year's forecast of $118.0 billion for 1986. For 1987, the result is total funding of $123.6 billion. That is a decrease of 1.1% from the $125 billion forecast of a year ago.

Performance data for 1987 resulting from these revisions were given earlier in this article as percentages for comparison with the 1988 forecast. The actual dollar revisions were a decrease from $91.0 billion to $89.5 billion for industry; an increase from $15.2 billion to $15.3 billion for Federal laboratories; and no change in the academic–nonprofit sector at $18.8 billion.

The balance of this article is devoted to discussing the factors that influence the funding provided by each sector and the performance of R&D by each sector as funds are transferred and spent.

Industry: funding up 6.8%, performance up 7.0%

Corporate profitability improved in the second half of 1987. Cahners Economics forecasts a healthy increase of almost 13% in 1988, along with real growth in GNP of 3.1%. With inflation, total GNP will increase 6 to 7%. We expect industrial funding of R&D to increase 6.8%.

Not all parts of industry will experience equal growth, either overall or in R&D. The largest growth is expected in nonelectrical machinery, a category that includes computers (because the first "computers" were punch-card sorters and it is hard to change established statistical categories because of the expense of revising past data). Advances in computer technology are coming so rapidly that firms have no choice but to fund ongoing R&D if they are to remain competitive.

Other areas in which good growth can be expected are pharmaceuticals and biotechnology, electronics, and instruments and test equipment, the latter being primarily affected by the electronics area. Despite the improving economic picture for the petroleum and primary metals industries, R&D funding is not expected to increase in those areas.

The worst news for R&D is in the automotive sector. Production cuts and costly incentive programs, designed to boost sagging sales, will curtail funding.

Federal funds support much of industry research and development. Taking this into consideration, performance of R&D by industry is expected to increase 7% in 1988.

Federal: funding up 6.7%, performance down 3.3%

The original budget submitted by President Reagan included $62.4 billion for R&D in fiscal 1988. With cutbacks for deficit reduction, the R&D forecast of $64.0 billion for calendar 1988 seems impossible. The explanation lies primarily in how the U.S. government operates.

Congress modifies the budget and passes its own budget resolution. Authorization bills specify what activities are to be supported and, finally, appropriation bills authorize expenditures. Then the Executive branch obligates the funds to specific activities and contracts, which may include actual spending in later years.

In 1988, once again, a significant carryover from earlier fiscal years continues to support R&D. In effect, this tends to average out changes in Federal sector funding.

But, when deficit reduction rears its head, those in R&D pay attention. Every source of R&D funds in the Federal government is in the "controllable" portion of the budget—the part that is easiest to cut. If Gramm-Rudman-Hollings had been fully implemented, Dept. of Defense R&D activities would have suffered. One scientist calculated that only funds for salaries would be available in DOD laboratories, leaving no money to support other R&D costs.

But in the civilian sector, funds for research and development would have been subjected to a cut of 8.5% if cuts were distributed evenly over the controllable portion of the budget. In most cases this would have led to a net increase in R&D funding. President Reagan's budget had called for an 8% increase. Both the Administration and Congress had added items to the civilian portion of the budget. Our calculations indicate that Federal funding, outside DOD, would have still been about 2.5% larger than in fiscal 1987.

The inability of Congress to pass budget and ap-

propriation bills until late December also had the effect of pushing funds into calendar 1988.

Performance of R&D in government laboratories is expected to decrease in 1988, partly because of cutbacks in the energy and pollution fields from the high levels of earlier years, and partly because of efforts to hold down "in-house" costs in administering external programs.

Others: funding up 10.0%, performance up 8.5%

While this sector has the largest percentage of increase, the dollar amounts are comparatively small. Increasing overhead costs lead to a need for increased self funding, particularly when new cooperative ventures are being negotiated and after they are formed.

Inflation or real growth?

Cahners Economics forecasts a 3.1% increase in gross national product in 1988, expressed in constant dollars based on the worth of a dollar in 1982. To express GNP increases in current dollars, an inflation factor has to be added. Any of several factors can be used.

Cahners Economics is forecasting 1988 inflation as 3.8% in the consumer price index, 4.1% for imported consumer goods, but only 3.0% for producer and industrial prices. Federal government agencies use an implicit price deflator that is set and mandated by the Office of Management & Budget.

No measure of inflation has been established specifically for research and development. Because salaries constitute a substantial portion of R&D costs, we feel that such a specific factor would lie between the consumer and the producer price indices. In that case, the R&D field can expect to see real growth in 1988 that is somewhat higher than the forecasted growth in gross national product.

That is better than might have been expected amid the squalls of this past fall. On the basis of this Forecast, real growth is expected to be just slightly higher than that of the gross national product. R&D

Reader Response Panel

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C.J. Moabacher has continued as a consultant to *Research & Development* magazine since he retired as Executive Editor on January 1, 1986.

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FARMER COOPERATIVE NUMBERS AND MEMBERSHIPS, 1986

Component	Cooperatives Number	Memberships Number
Products marketed:		
Cotton	396	94,749
Dairy	345	152,881
Fruits & vegetables	344	61,880
Grain and soybeans	1,514	909,643
Livestock, wool & poultry	469	450,120
Rice	49	20,600
Sugar products	40	8,020
Other (beans, peas, nuts, tobacco & miscellaneous)	103	315,031
Total farm products	3,260	2,012,924
Total farm supplies	1,971	2,225,550
Total services	138	163,283
TOTAL	5,369	4,401,757

Note: Information is preliminary. Many cooperatives are multiproduct and multifunctional in operations and are classified according to predominant commodity or function indicated by business volume.

Source: "Farmer Cooperatives," October, 1987, page 8, published by the Agricultural Cooperative Service, U.S. Department of Agriculture.

million, up from $347.5 in 1985. More than half of the sales are to foreign countries.

Growth has come through finding new uses and new markets. *Blue Diamond* almonds are used in more than 2,000 different ways and sold in 88 foreign countries.

The world's largest

The Tree Top cooperative in Selah, WA, world's largest apple processing company, had retail sales of $187 million last year. Total sales by the company accounted for one-sixth of the state's $3 billion ag industry.

The crops of the more than 3,800 grower-members are processed in one of the co-ops four processing plants into a wide range of juice products, concentrates, frozen, and dried products.

John McAlister, director, public affairs, credits the success of the co-op to responsive and aggressive marketing.

But being a co-op, says McAlister and many of his co-op counterparts, "is a mixed blessing." When times are good, everything is fine. But "there is always a shortage of capital for future expansion. If we want to develop new products or build a new plant we are very limited to the amount of capital resources we can extract from the co-op," he says.

Building consumption

Riceland Foods, Inc., Stuttgart, AR, a co-op of 11,500 farmer members in Arkansas and nearby states, is the largest miller of rice in the U.S., the nation's fifth largest grain storage company and a Fortune 500 company. "Each year," says Bill Reed, vice president, corporate development, "we mill and market approximately one-half of the Arkansas rice crop, which figures to be about 20 percent of the U.S. rice crop."

They have been leaders in what they do best: marketing rice. Per capita consumption of rice is now 17.4 pounds, up from 9.1 in 1975. By finding international markets and working with federal programs, the co-op has been able to work off their surplus. U.S. rice is now sold into roughly 75 different countries by Riceland.

Riceland also has an edible oil operation producing a wide range of soybean oil products and the co-op is one of only two manufacturers of oil-free lecithin in the U.S. Riceland products are marketed under the *Riceland* and *Chefway* names.

Looking to the future

Despite the difficulties of recent years, there is optimism heading into the 1990s. Says Ralph Hofstadt, president of Land O'Lakes, "I'm very optimistic, but only if this group of organizations can clearly see the kind of business environment they will be operating in. It will be volatile, but very exciting. We have to develop new programs and change present structures."

What the co-ops have to look forward to is continued merger, acquisition and joint venture activity. They must continue to market aggressively, both internationally and domestically. The battle for share of market will continue to be waged around the globe.

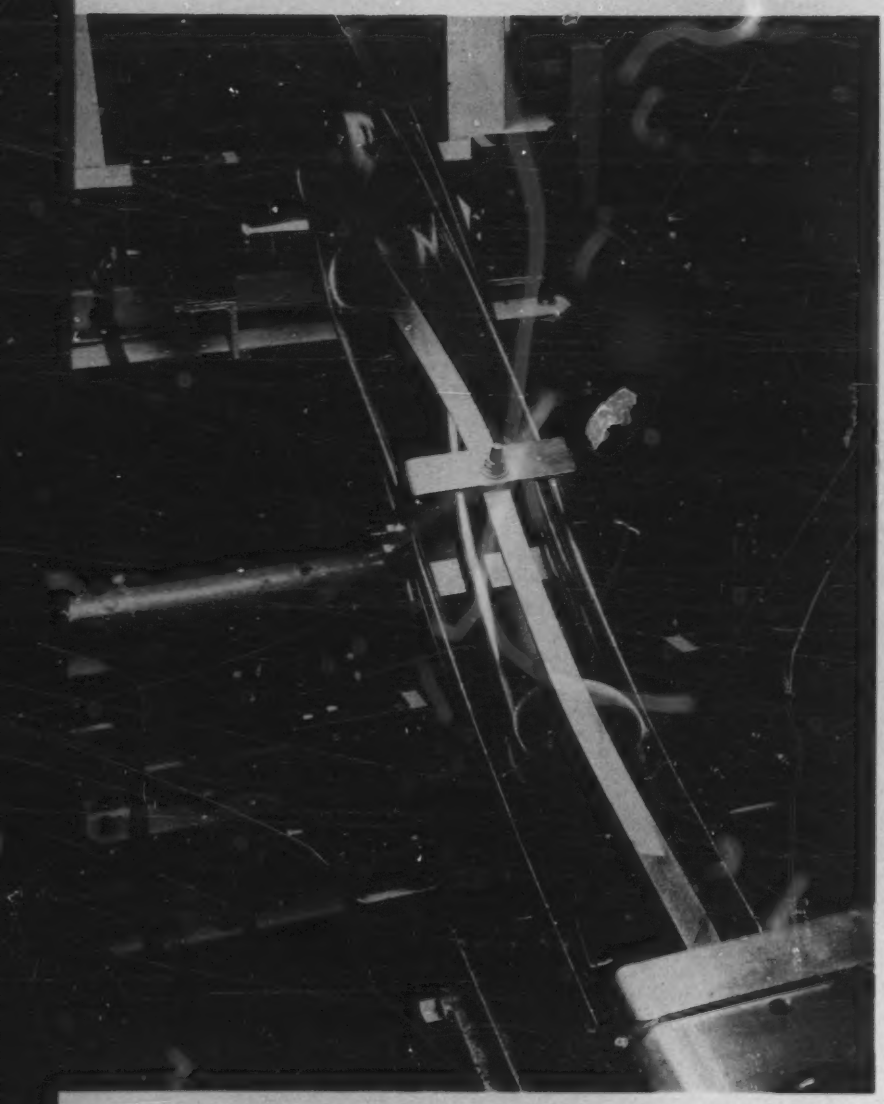
At Sun-Diamond's cannery operation, shelled walnuts are routed to cans where they are automatically filled.

Special Emphasis

CANNING MACHINERY

CANNING INDUSTRY: METAL VS. PLASTIC

Closing and inspection systems offer speed, efficiency, and product integrity to the traditional can line. But the metal can line may be affected by a new force in packaging design: plastic cans.



Photoelectric sensors from Omron Electronics monitor operations on a high-speed canning line. The sensors are able to detect jams on the line.

Canned foods and the canning industry have been around for so long that they are often taken for granted. In 1810, Nicholas Appert, a Frenchman, published the first book on canning methods and introduced a new form of food preservation. As a result, canned foods were most likely the first convenience foods.

While the advent of plastics and plastic cans is beginning to mean additional competition, the metal can still has continued to maintain a strong position in the food industry, most notably in beverages.

Recent trends in fact indicate that metal can manufacturers can expect significant growth over the next decade. The amount of can sales to major end-group users, (excluding pet foods), according to the Can Manufacturers Institute, Washington, DC, shows that 23.4 billion units of cans were sold in 1986. In the beer and soft drink category, 72.9 billion cans were shipped to manufacturers in 1986.

The most recent estimates for 1987, according to the U.S. Industrial Outlook of the U.S. Department of Commerce, show that 27.2 billion units of metal cans were shipped to major end-group users. And, in the beer and soft drink area, 78 billion units were shipped to manufacturers during the same time period.

Canning equipment

Because the canning industry is always looking to improve processing methods and to enhance product quality, safety and efficiency, canning and seaming equipment and the inspection systems to accompany them have reached an extremely high level of speed and accuracy.

For example, Continental Container Systems, a division of Continental Can Compa-

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Senior Associate Editor

ny, Inc., West Chicago, IL, has several lines of closing machines, the most versatile being the *2000 Series*, three basic units which can accommodate a wide range of packaging. The *2003 RCM1* three-spindle machine will close 401 through 610 diameter cans at speeds up to 300 cpm. The *2004 RCM1* four-spindle machine closes 202 through 408 diameter cans at 400 cpm. And the six-spindle *2006 RCM1*, will do 202 through 404 diameter cans at 600 cpm.

The 2000 series is designed for height changeovers that can be done in several minutes, because of a new design that provides for the support and driving of all height-change-related components directly from the machine's upper housing. This eliminates the need for sliding shaft and key fits.

Another major supplier of seaming equipment, Angelus Sanitary Can Machine Company, Los Angeles, CA, has a straight-line feed seamer, *model 61H*, that provides high-speed operation with semi-automatic lubrication to minimize downtime and maintenance costs. Cans are seamed at high speed in a six-spindle "can spin" turret. Each spindle has durable, large-diameter first and second operation seaming rolls mounted on tapered roll bearings. Seaming rolls can be individually adjusted for height and seam thickness.

A closing machine which meets the industry's needs for speed, reduced spillage and low maintenance costs has been introduced by FMC, Madera, CA, as the *FMC 952*. This model is a sixteen-spindle closer using can rotating seaming principles which means that it runs faster but at the same time, provides gentler handling of lightweight cans because of lower seaming. The 952 reduces spillage through effective can spacing of the closer infeed chain and seaming head. This allows ideal synchronization to all of the fillers and minimizes can acceleration. The machine, used mainly for beverage, closes up to 2000 cpm.

Hema International, Sandy, UT, has a vacuum seamer, *model SHV60*, which is designed for round and odd-shape containers. This is an automatic seamer which can be adapted to a particular application. The seaming head allows first and second seaming operations, and is mounted on a heavy duty, articulated arm, allowing the head to swing out of the main frame. Adjustments and changeovers are easy. The SHV60 runs at speeds of 15 to 120 cpm depending on the size of the container. In addition, Hema is developing a new model which will allow speeds up to 200 cpm, and will also greatly facilitate adjustments and changeovers.

Inspection systems

Even though it is usually fast and efficient, a canning operation is only as good as its monitoring system. The canning operation's accuracy depends on two main factors: that seaming equipment is operating correctly and inspection/detection systems for poor vacuum, incomplete fills and defective cans are operational.

The integrity of double seams is of vital importance in the canning process. With the speed and complexity of current equipment, visual inspection of random samples from the line is no longer acceptable to maintain a high quality product.

For this reason, new technologies have been developed for inspection on the line, one of which is Continental Can's *In-Line Double Seam Tightness Monitor*. The In-Line Monitor allows 100 percent monitoring of double seam tightness for every can before it leaves the closing machine with no effect on speed. An acceptable pressure range curve between the rolls and the chuck is selected, and the monitor matches the image of the actual pressure curve around the seam against the parameters in the software. The system alerts the operator of out-of-limits conditions through a status printer and monitor warning system. The removal

Major markets for metal food and beverage cans (Millions of dollars)

Year	Manufacturers' Sales of Metal cans	Annual Percent Change	Soft drinks, beer	Fruits, Vegetables, Juices	All other foods
1984	$11,621.4	10.1	7,640.6	1,743.7	2,128.4
1985E	12,667.1	9.0	8,463.5	1,975.6	2,228.0
1986E	13,304.6	5.0	8,810.0	2,090.2	2,404.4
1995P	25,120.0	7.0*	17,079.4	3,639.4	4,401.2

*Compounded Annual Average E – Estimate by BTA P – Projection by BTA
Source: U.S Department of Commerce; Business Trade Analysts

of questionable containers is accomplished by one of two optional integrated reject mechanisms.

The Double Seam Monitor is available as an option on new Continental Can rotary closing machines. It is also available as a retrofit for the existing 2000 Series.

Along the same lines, Dun-Rite Products, Barrington, IL, offers its *Double Seam Monitor System (DSM)*, which performs single or double can end sampling anywhere within the can line system. As a can is transferred onto the DSM system, it is stabilized, metered and positioned through the sensing zone. The can is rotated three times in front of the sensing bar assembly and the double seam is sampled for defects. If the double seam qualifies, the can remains on the line. If it does not qualify, the can is ejected from the line for inspection.

The DSM system can be incorporated into existing can lines for sampling of one or both double seams. The monitor system can sample up to 350 cpm. A built-in controller maintains proper can traffic on the line and Dun-Rite advises that cans should not idle on the DSM system.

Another form of on-line monitoring is vacuum inspection, which uses sensors to detect containers with poor vacuums. When a metal surface is stressed by vacuum, it is drawn into a concave shape. Greater vacuums will create greater degrees of concavity. These systems reject containers when the vacuum is insufficient to pull the can end inward beyond a threshold value locked in a sensing panel.

Key Technology, Walla Walla, WA, offers the *1200 Series of Dud Detectors*, which tests both ends of a can concurrently. Sensors located under the belt and in the top reference assembly measure can lid deflection and compare the readings to adjustable set points. Low vacuum cans and leakers are removed from the line at up to 1200 cpm.

Peco-Controls, Milpitas, CA, offers its *VAC-TRAC* dud-ejector system which checks each container for end-deflection by a three-point proximity sensing method. Each container passes under the sensor head, where outer sensors measure and average reference depth at the container's outermost edge. A middle sensor measures depth at the center on the container's end. Container end deflection is determined by subtracting the center-end measurement from the average signals on the outermost edge. The system has the capability to scan at 750 cpm.

An inspection system which is used on dedicated can lines from 202 size or greater is available from TapTone Container Inspection Systems, a division of Benthos, Inc., North Falmouth, MA. The *Standard Vacuum Profiler* uses a sensor to define a can end and can scan up to 1200 cpm. As a container passes under the sensor, a measurement is made defining the shape, or profile, of the container end and sensor output will vary according to the shape of the surface.

This vacuum seamer, model SHV 60, from Hema International, operates according to the double seam principle and can accommodate a wide range of containers.

In the case of a can end, the Profiler measures and responds to the degree of curvature of the end, which is electronically measured and compared with a preset "good" and "bad" profile. The system has a circuit concept which electronically stores these profiles. Assuming the production process is controlled, the curvature should remain consistent. If vacuum is lost, the curvature or the profile changes. A proportional readout indicates the degree of vacuum. The Profiler senses this profile change, and rejects the container with the defective profile.

Specialized systems

Inspection, however, is not just a matter of safety, and that is where a photoelectric sensor system, like that available from Omron Electronics, Schaumburg, IL, is ideal to check for proper can orientation. Omron's sensing system consists of a pulse-modulated infrared LED and special reflector and aspheric lenses. When used with a programmable controller, these sensors, the Omron *E3S-R* and *S3D8*, and the controller are able to detect upstream and downstream jams on the line. When the sensor detects the presence of cans, the PC uses internal timers to check if cans are not moving past the sensor at regular intervals (upstream jam) or are sitting still on the line (downstream jam).

The Angelus seamer, model 61H, provides high speed operation with semi-automatic lubrication to minimize downtime and maintenance costs.

The system will then reject or re-route the appropriate containers.

A new trend?

Are plastic cans the wave of the future in the canning industry? They may be, because, plastics have entered the canning marketplace bringing with them great capabilities.

Products packed in plastic containers are lighter in weight than their metal counterparts and are easily stored. They are microwaveable, which right now is a large plus. Presently, plastic containers are more expensive than metal cans but there is evidence that the cost gap is closing. It is believed, however, that small processors cannot afford a changeover to plastics until the price of the containers becomes at least comparable to metal.

The "Omni", for example, is a rigid plastic can developed by American National Can Company, Greenwich, CT. Composed of polyolefin, it is white, with one metal end where the seaming operation occurs. The container is retortable and has a high oxygen barrier, giving the packaged product a long shelf life. Probably the best consumer advantage of the container is that it is microwaveable. The container cannot be recycled but can be fully incinerated, giving off no harmful by-products.

According to American National Can, the Omni container can be used on any existing seaming equipment with some slight modifications. Currently, Hormel Co. is the only processor that is using the Omni can for its meat-based products. In addition, American National Can will be marketing several more Omni can applications in the first quarter of 1988. The containers will be both cylindrical and bowl-shaped.

The newest entry into the plastic can market, the Petainer, was developed by the Petainer Development Company, Atlanta, GA. It is currently being used for beverages in several test markets.

The Petainer can has a standard aluminum lid, is of low barrier layer construction, and has a PVC label. The container has a 15-16 week shelf life but cannot be used in a retort system. The Coca Cola Company had, until recently, test marketed the Petainer exclusively. Original New York Seltzer has since picked up on the use of the Petainer and has launched five of its ten flavored drinks in several test markets, two of which are Detroit and Boston. The container can be run on standard seaming equipment.

However, what if both ends of the can are plastic? We talked to Akerlund and Rausing, of Lund, Sweden, which has introduced its form of the plastic container into the Swedish market under the trade name *Letpak*.

Letpak is a three-piece container in which the can's case, lid and base are composed of polypropylene with a thin barrier lamination of aluminum. One end is sealed to the body by the manufacturer, the other is sealed at the point of fill. Inductive high-frequency welding gives the container a perfect seal.

According to Akerlund and Rausing, the container can be run on standard canning equipment with the addition of a special Letpak sealer. If magnetic conveyors are used on the line, they too must be changed. The line can run up to 200 cpm.

Presently three fruit products packed in the container have been test marketed in Sweden. Letpak has been developed for the worldwide market and will be widely available by 1990.

Here to stay

Most packaging authorities and forecasters will agree that the plastic can is here to stay. The advent of the plastics industry has forever changed the scope of packaging. It is interesting to note, though, the metal institutional can, number ten, has been untouched by the plastics market.

The plastic container is seen as a viable alternative to the metal can. However, this does not mean the end of metal cans—or the machinery to seam them. This machinery is adaptable, and with modifications, can seam metal-end plastic cans and all-plastic cans. It appears that conventional seaming equipment will not go obsolete—as long as a container has an end to be seamed.